Complete

PUBLIC ROADS

A JOURNAL OF HIGHWAY RESEARCH

UNITED STATES DEPARTMENT OF AGRICULTURE
BUREAU OF PUBLIC ROADS

TRANSPORTATION LIBRARY

INDEX
TO VOLUME 13

MARCH 1932-FEBRUARY 1933

For sale by the Superintendent of Documents, Washington, D.C. . . . . Price 5 cents

CHRONOLOGICAL LIST OF ARTICLES

MARCH 1932: Page

THE WESTERN STATES TRAFFIC SURVEY 1
TRUCK GREAT FACTOR IN FARM FREIGHTING 19
PROGRAMS OF ESTIMATED STATE AND LOCAL HIGHWAY AND BRIDGE EXPENDITURES FOR CALENDAR YEAR 1932 20

APRIL 1932:

WHERE THE HIGHWAY DOLLAR GOES 21
THE RESISTANCE OF CONCRETE TO FROST ACTION 32
1931 MOTOR VEHICLE REGISTRATIONS AND RECEIPTS 39

MAY 1932:

HIGHWAY TRAFFIC CAPACITY 41
CONCRETE PAVEMENT DESIGN FEATURES, 1931 47
PUBLICATIONS OF THE BUREAU OF PUBLIC ROADS 52

JUNE 1932:

STABILIZATION BY DRAINAGE OF MUCK AND SAND FILL 57
THE SEGREGATION OF WATER IN CONCRETE PLACED IN DEEP FORMS 64
GASOLINE TAXES, 1931 70

JULY 1932:

THE DESIGN OF STREET AND HIGHWAY INTERSECTIONS 73

AUGUST 1932:

RATIONALIZATION AND SIMPLIFICATION OF TEST REQUIREMENTS FOR LIQUID ASPHALTIC MATERIALS 89
THE BATCHING PLANT IN CONCRETE PAVING WORK 97
CONNECTICUT AVENUE EXPERIMENTAL ROAD NOW 20 YEARS OLD 104

SEPTEMBER 1932: Page

STATIC LOAD AND IMPACT TESTS OF LIGHTWEIGHT BRIDGE FLOOR SLABS 105
BITUMINOUS CONCRETE ON CONNECTICUT AVENUE EXPERIMENTAL ROAD 120

OCTOBER 1932:

RESEARCH ON THE ATTERBERG LIMITS OF SOILS 121
THE NEW HAMPSHIRE TRAFFIC SURVEY 131
CEMENT CONCRETE GIVES GOOD SERVICE ON CONNECTICUT AVENUE EXPERIMENTAL ROAD 136

NOVEMBER 1932:

ROAD IMPACT PRODUCED BY A HEAVY MOTOR BUS 137
EXTRA WIDE HIGHWAYS ON STATE SYSTEMS 148
STATE AND LOCAL GOVERNMENTAL AGENCIES EXEMPT FROM FEDERAL EXCISE TAXES 150
VITRIFIED BRICK ON CONNECTICUT AVENUE EXPERIMENTAL ROAD 150
WASHING MACHINE DESIGNED FOR USE IN DETERMINING CONSTITUENTS OF FRESH CONCRETE 151

DECEMBER 1932:

THE PROBLEM OF MOTOR VEHICLE REGULATION 153

JANUARY 1933:

SURFACE TREATMENT OF TOPSOIL ROADS 169
EFFECT OF SIZE OF SPECIMEN, SIZE OF AGGREGATE, AND METHOD OF LOADING UPON THE UNIFORMITY OF FLEXURAL STRENGTH TESTS 177

FEBRUARY 1933:

A SURVEY OF HIGHWAY TRANSPORTATION IN MICHIGAN 185
MOTOR TOURIST TRAFFIC IN MICHIGAN 197

LIST OF AUTHORS

ANDERSON, ANDREW P.
BLANCHETTE, WILLIAM A.
BROWN, R. D.
BUCHANAN, JAMES A.
CASAGRANDE, ARTHUR
CRITZ, PAUL F.
DAVIS, G. W.
HARRISON, J. L.
HOGENTOGLER, C. A.
HOLMES, E. H.
HUBBARD, PREVOST
JACKSON, F. H.
JOHNSON, DEAN A. N.
KELLERMANN, W. F.
KELLEY, E. F.
KELLY, H. H.
PEABODY, L. E.
TELLER, L. W.
TUTTLE, L. S.
WERNER, GEORGE
WILLIAMSON, J. S.
WILLIS, E. A.

ABBREVIATIONS

a.—article(s), report(s)
fn.—footnote
r.—reference, referred to
r. to p.—reference(s) to publication(s)
Headings cited in cross references

INDEX TO PUBLIC ROADS, VOLUME 13

A

Page

Abrasion tests of coarse aggregates 32-37, 56
Absorption tests, absorptive properties, of aggregates 32-37, 56, 65, 174, 178
Accelerometers 54, 108, 137-139
Accidents, highway; highway safety 45, 55, 74-88, 148, 153-167
Adhesive properties of soils, sticky limit ..... 121 (text and fn.), 128
Administration, highway 55, 185, 187
see also headings beginning Federal, State.
Age limits for motor vehicle drivers 156, 166, 167
Age-strength relations of briquets and of concrete .. 32-34, 65, 66, 68, 69, 106, 119, 178-180
Agg, Prof. T. R 193, 194
Aggregates:
costs and production 21-26, 30, 54, 55
segregation 65-67, 69, 72, 120
types and gradings used and effects observed .. 32-38, 50 (fn.), 64, 65, 104-106, 119, 120, 136, 150, 176-184
Alabama highways and related data 20, 39, 40, 50, 51, 70, 71, 89-96, 104, 149, 166, 167
see also Federal-aid.
Allegheny County, Pa.:
cooperative tests of bridge slabs, a 105-120
Analyses, *see* Bitumen, bituminous materials—Dunagan method—Sieves.
Anderson, Andrew P., a 97-103
Apparatus, *see* names of kinds of apparatus; *also* names of tests and of processes in which apparatus is used.
Arizona highways and related data 1-18, 20, 39, 40, 50, 51, 70, 71, 89-96, 104, 149, 155, 158, 166, 167
see also Federal-aid.
Arkansas highways and related data 20, 39, 40, 50, 51, 70, 71, 89-96, 104, 149, 158, 166, 167
see also Federal-aid.
Asphalt cements, bituminous binders 91, 93-96, 120, 169-176, 184
Asphalt content test of asphaltic materials ... 90, 92-95
Asphaltenes 95, 96
Asphalts, *see* Bitumen—Bituminous roads.
Assessments, property 193
Atterberg soil tests 52, 121-130, 136
Automobiles, *see* Motor vehicles.
Aviation gas tax 71

B

Bars, steel, *see* Steel.
Basalt concrete, freezing test data 32-38
Base courses 104, 120, 150, 151, 169-176
Batching plant in concrete paving work, a 97-103
Beacons (flashing, reflecting) 74, 75, 78, 86
Bending moments, bending stresses:
in concrete 177-184
see also Flexural strength—Stresses.
Bibliography and lists of publications ..... 52-56, 136; rear covers of Nos. 1, 2, 4, 5, 10-12
Binders, binding materials:
bituminous binders 91, 93-96, 120, 169-176, 184
clay binders 175
Bins, *see* Material handling.
Bitumen, bituminous materials:
analyses and results of 89-96, 104, 171, 176
liquid asphaltic materials, rationalization of test requirements, a 89-96, 104
paving asphalts, grades 96, 104
physical changes after exposure 176
types and application methods used 53, 95, 104, 120, 136, 169-176, 184
see also Fillers.
Bituminous roads:
bituminous concrete roads 17, 55, 104, 120, 148, 149
bituminous macadam roads 18, 104, 148, 149, 193
see also Impact—State highways.
Bituminous surface treatment of roads 17, 53, 104, 136, 149, 169-176, 184
Blanchette, William A., a 151-152
Bond:
between concrete and steel 105, 118-120
between mortar and aggregate in freezing concrete 34-36
in treated and in untreated soil roads 169, 170, 174, 175
Bonds:
and insurance as factors in costs of roads 22, 23, 26, 29, 30
highway bonds 20, 40, 55, 70, 71, 193
"Bottle necks" and traffic movement 6
Boulevards and parkways 56, 79, 83-88, 148, 149
Braking of motor vehicles 157, 162, 164, 167
Brick pavements 20, 54, 104, 148-151, 193
Bridges and bridge traffic ..... 20, 40 (fn), 54-56, 142, 143, 164, 166, 200
British design of road intersection 80

Page

Brown, R. D., a 47-52, 104
Buchanan, James A. (J. A.), a., r. to p ..... 54, 137-147, 151, 164 (fn)
Bulletins:
discontinuance of 52
see also Bibliography.

C

Caliche road 17
California highways and related data 1-20, 39, 40, 47, 49-51, 70, 71, 79, 81, 89-96, 104, 149, 155-158, 160, 166, 167
see also Federal-aid.
Canada-Michigan traffic 197-200
Capillarity of soils, capillary moisture in soils .. 53, 59, 60, 175
Carbon content of bituminous materials .. 92, 94, 171, 176
Carbon disulphide test of bituminous materials .. 90, 91, 94, 95, 176
Carbon tetrachloride test of bituminous materials .. 92, 94
Casagrande, Arthur, a. and r. to p 121-130, 136
Cement and cement handling 21-32, 54, 56, 65, 97-103, 119, 178
see also Proportioning.
Cement grout filler, use 150
Centrifugal force, relation to vehicle speed at highway curves 73
Ceramic industry and materials ..... 121 (fn), 136
Certificates of convenience and necessity 155, 159-161, 165
Certificates of title, motor vehicle 155, 163, 166, 167
Chauffeurs, *see* Drivers.
Cigarettes, motor vehicle legislation concerning .. 156
Circular roadways 74-88
City streets and traffic, city owned motor vehicles .. 1-3, 10, 20 (fn), 40 (fn), 70, 71, 148, 149, 167, 185, 187, 190-196, 200
Classification:
of highways, *see* Traffic studies.
of soils, *see* Soil classification.
Clays and clayey soils, clay content of soils 53, 57-59, 65, 121-130, 136, 170, 175, 178
Clearance of overhead structures, r 164
Climatic conditions, weather conditions, as affecting:
design of concrete pavements 48, 49
road surfaces 18, 176, 184
soil test procedure 125-128
traffic density 3, 6, 18, 187
Code, vehicle 161, 163-165
Cohesion in soils ..... 58, 121 (text and fn), 127, 130, 175
Colloid content of soils 58, 59, 127
Colorado highways and related data 1-18, 20, 39, 40, 50, 51, 70, 71, 89-96, 104, 149, 155, 166, 167
see also Federal-aid.
Columbia Island, stabilization by drainage .. 57-63, 72
Common carriers 2, 3, 55, 153-168
see also Freight—Railroads.
Compaction, *see* Placing of concrete—Stabilization.
Competition between forms of transport 19, 153, 157-162, 165, 166
Compressibility of soils 59, 60, 122-124, 130, 136
Compression tests, compressive strength, of concrete 53, 54, 66, 68, 69, 72, 106, 112, 114, 117, 119, 177
Compressive stresses in steel reinforcement 105-120
Concrete:
fresh concrete, washing machine for 151-152
placing methods and effects of 54, 64-69, 72, 106, 119, 120
r. to p 53-56
resistance to frost action 32-38, 54, 104
size of specimen, effect upon flexural strength .. 177-184
Concrete bases of road surfaces 120, 150, 151
Concrete batching plant, a 97-103
Concrete bridge floor slabs 54, 56, 105-120
Concrete mixers 55, 65, 97-103, 106
Concrete mixing methods 33, 55, 65, 97, 103, 106, 178
Concrete pavements:
construction, cost distribution 21-31, 38
design features 47-52, 54, 104
impact test data 141-147, 151
see also Federal-aid—State highways.
Concrete reinforcement, reinforced concrete 21-23, 28, 30, 47-50, 53, 56, 105-120
Condition data for roads, wear of roads 16, 18, 53, 54, 104, 120, 136, 151, 169-176, 184
Conferences, conference committees 161-163
Connecticut Avenue experimental road 53, 54, 104, 120, 136, 150, 151
Connecticut highways and related data ..... 10(fn.), 19, 20, 39-46, 50, 51, 70, 71, 89-96, 104, 149, 155, 156, 166, 167.
see also Federal-aid

Consistency:
of bituminous materials, *see* Penetration.
of cement, test results 65, 178
of concrete, slump 33, 34, 53, 64, 65, 67-69, 72, 106, 178, 181
of soils 52, 121, 126, 128
see also Plasticity.
Contract hauling, motor truck .. 2, 3, 154, 157-162, 164-166
Contract work, contract forms 21-24, 52
Contraction:
of concrete 53, 118, 119
of soils, *see* Shrinkage.
Corrections, correction factors 91, 108, 118, 152
Corrugations, road 53, 141-144
Cost data:
for bituminous roads 104, 120, 136, 169-176, 184
for brick road on concrete base 150, 151
for concrete roads 21-31, 38, 100, 102, 103, 136
for gravel roads (general) 18
see also Accidents—Federal-aid—Operating costs—Tourist traffic.
Cost price, motor vehicle 158
County roads and traffic upon .. 20 (fn), 40, 71, 185-193, 196
Cover material 169-176, 184
Crack fillers, joint fillers 49, 51, 52, 150, 151
Cracks:
in roads and slabs ..... 49, 53, 54, 111, 118, 119, 136, 150, 151, 164 (fn), 174, 184
in soils 57, 60, 62, 63
Crane operation, cranes 97, 98, 101
Critz, Paul F., (joint author), a 169-176, 184
Crosswalks at highway intersections 79
Crowns, road 47, 48, 50, 184
Cup flash testers 91, 94
Curbs, curb radii 48, 54, 73-88
Curing methods, curing periods for concrete 33, 34, 53, 54, 65, 66, 106, 119, 178
Curves, highway 52, 74-88, 144, 164
Cushioning, *see* Impact—Sand cushion.
Cut-back products 91-96, 104, 169-176, 184

D

Davis, G. W., (joint author), a 105-120
Deflection-measuring equipment 117
Deflections:
in concrete bridge slabs 105, 107-120
in springs 110, 138, 139
in steel reinforcement 107-120
Deformations of motor bus tires 137-140
Delaware highways and related data .. 19, 20, 39, 40, 50, 51, 70, 71, 89-96, 104, 149, 156, 157, 159, 166, 167
see also Federal-aid.
Delaware River Bridge tests ..... 56, 105 (fn), 108
Density, traffic, *see* Traffic studies.
Depreciation and depletion as factors in highway costs 23, 25-31, 88
Depth, *see* Thickness.
Design, highway 6, 7, 16, 18, 47-54, 73-88, 104
see also names of types of highways and names of features of design.
Diabase concrete, freezing test data 32-38
Diatoms 59
Dikes, Columbia Island 60-63
Disintegration of concrete and of aggregates .. 33-38, 64
Distillates, distillation tests .. 71, 89-96, 104, 169, 171, 176
District of Columbia, streets and related data .... 39-41, 45, 46, 53, 54, 57-63, 70-72, 76, 77, 81, 104, 120, 136-147, 150, 151, 153-155, 159, 163, 167, 168.
Dollar, highway, a 21-31, 38
Dolomite chats 171
Dolomite concrete, freezing test data 32-38
Dowels, dowel steel 28, 47-52
Drainage and drains 57-63, 72, 136
Drivers of motor vehicles, chauffeurs' permits 40, 41, 156, 159-167
Dual roads 148, 149
Ductility test of residue 91, 92, 94, 95
Dunagan method of analysis of concrete .. 66, 67, 72, 151
Durability of concrete 64-69, 72, 120
Dust, limestone, as filler 120
Dust prevention, dust layers 91, 169, 184
Dye adsorption test results (topsoil) 170
Dye test of bond of steel and concrete 118, 119

E

Earth and gravel roads ..... 16-18, 20, 47, 53, 144, 149 (fn.), 169-176, 184
Economics, highway, *see* Farm freighting—Improvement of highways—Operating costs—Regulation, motor vehicle—Traffic studies.
Edge design of concrete pavements, edge bars 47-51
Edge tests of concrete bridge slabs 107, 109, 110, 114
Elasticity:
of concrete 54, 109, 112, 118
of soils as affected by mica content 136
Electricity in scalelike particles of soil 128
Employment, *see* Drivers—Unemployment.

Page

Emulsions, emulsified asphalts, use 171–176
Equipment, road building 21–31, 54, 55, 97–103
Evaporation of soil moisture 57, 60, 63, 125–127, 130, 175
Excise taxes 150, 158
Exemption, tax 39, 70, 150
Expansion:
  of concrete 53, 150
  of mortar during freezing 33–38
  of soils 57–59
Expenditures:
  by tourists, Michigan data 198, 199
  highway expenditures 16, 20–31, 38, 55, 56, 153, 154, 185, 192–194
  see also Federal aid—Revenues, highway.
Experimental roads 53, 54, 104, 120, 136, 150, 151, 169–176, 184
Explosives 27

F

Farm freighting by motor truck 19
Farm machinery, exemption from restrictions. 167 (fn.)
Farm ownership, rural ownership, of motor vehicles 1–3, 10, 155, 159, 161
Federal-aid road act 21, 154
Federal-aid road construction 21–31, 38, 47–52, 54, 55, 104; rear covers of Nos. 1–11
Federal control of highway transportation 165, 166
Fees, *see* License fees—Mileage fees—Registration(s).
Feldspar powder 128, 129
Ferry traffic, Canada-Michigan 197–200
Fillers 49, 51, 52, 120, 150, 151
Fills, earth 52, 57–63, 72, 142, 144, 150
Finance, highway, *see* Expenditures—Federal-aid—Improvement—Revenues—State highways.
Financial responsibility, motor vehicle regulations concerning 155, 156, 160–163, 165
Fines 40, 71, 161
Finishing of concrete, methods 48, 106, 120, 178
Flash point tests of bituminous materials. 91, 92, 94, 171
Flexural strength, flexure tests, of concrete 33, 34, 38, 54, 105, 177–184
Float tests of bituminous materials 90–94, 171, 176
Florida highways and related data 19, 20, 39, 40, 50, 51, 54, 70, 71, 85, 86, 89–96, 104, 149, 156,158, 166, 167
  see also Federal-aid.
Flow:
  of soils, flow curves 58, 121–130
  see also Consistency—Traffic studies.
Flow table as apparatus for soil test 128
Flux, fluxes, fluxing:
  bituminous fluxes, fluxing 91, 93, 95, 96, 104, 120
  furnace flux, production data 25
Forecasts, traffic 1, 3, 10–16, 18, 131–136
Foreign, nonlocal, traffic on highways 1–5, 9–12, 15, 19, 131, 132, 153–166, 185–200
Forms, deep:
  concrete placed in, segregation of water in. 64–69, 72
Freezing:
  of concrete and of aggregates 32–38, 54, 104
  of soils 53, 57
Freight, freighting 19, 21–31, 102, 103, 155, 164(fn)
Friability:
  of concrete aggregates 35–38
  of soils, friable soils 125, 170(fn.), 175
Friction, hydrodynamic, in soils 125
Frictional stresses in, friction tests of, concrete 48, 53
Fruit transportation 19, 55
Fuel and power, cost data 23–31
Fuel tax, *see* Gasoline.

G

Gasoline consumption, gasoline tax, fuel tax 10–12, 28, 29, 40(fn), 55, 70, 71, 132, 158, 164, 165, 190, 198, 199
Georgia highways and related data 20, 39, 40, 50, 51, 53, 56, 70, 71, 89–96, 104, 149, 166, 167
  see also Federal-aid.
Glacial soils 127, 130
Grade crossings 6, 55, 103
Grade separation 79, 83(fn), 87, 88
Grading:
  highway grading 54, 55, 57, 78, 85
  see also Aggregates—Soil groups.
Grain size curves for different materials 128, 129
Grants of highway funds 40, 70, 71, 185, 192, 193
Gravel, *see* Aggregates—Earth and gravel roads—Glacial soils—Gravel concrete.
Gravel concrete 32–38, 54, 64–69, 72, 105–120, 136
Grooving tool, soil 122, 123, 125, 127, 128, 130
Ground-water elevation of soils 59–61
Grouting of brick road 150
Gypsum 27

H

Handling, material 21–31, 97–103
Hardening of bituminous materials 93–96, 172, 176
Harrison, J. L., a 21–31, 38
Haul, hauling 1–3, 9, 10, 19, 28, 54, 97–103, 154, 157–160
Hawaii, highways in, *see* Federal-aid.
Heaving:
  of joints, effect on impact 141–143
  of soils, freezing of soils 53, 57
Hiring, for-hire, motor vehicles; taxis 39, 55, 153–167
Hogentogler, C. A., (joint author), a. and r. to p. 57–63, 72, 136
Holiday traffic, *see* Traffic variations.
Holmes, E. H., (joint author), a 73–88
Honeycombing of aggregate 37

Page

Horsepower, motor vehicle 158
Hubbard, Prevost, (joint author), a 89–96, 104
Humidity as affecting soil test procedure 125–127
Hydrostatic uplift of soils 58

I

Ice machine 33, 34
Idaho highways and related data 1–18, 20, 39, 40, 70,71, 89–96, 104, 149, 155, 158, 166, 167
  see also Federal-aid.
Illinois highways and related data 19, 20, 39, 40, 50, 51, 55, 70, 71, 74, 80, 88–96, 104, 148, 149, 157, 166, 167, 185, 197, 198.
  see also Federal-aid.
Impact machine, impact tests 54, 105–120, 137–147, 151, 162, 164 (fn)
Improvement of highways, highway planning 10, 13, 16, 18, 21–31, 38, 52, 55, 56, 73–88, 131, 132, 189, 193, 194.
Indexes to Public Roads, notice 103
Indiana highways and related data 19, 20, 39, 40, 50, 51, 70, 71, 81, 82, 89–96, 104, 149, 156, 166, 167, 197, 198.
  see also Federal-aid.
Inspection of motor vehicles, compulsory. 157, 166, 167
Insurance:
  as factor in costs of road construction 22, 29, 30
  compulsory insurance of motor vehicles 155, 156, 160–163, 165
Intersections, highway 73–88, 187, 194, 195
Interstate traffic, *see* Foreign, nonlocal, traffic.
Iowa highways and related data 20, 39, 40, 50, 51, 70, 71, 89–96, 104, 149, 156, 157, 166, 167, 185, 193
  see also Federal-aid.
Islands, traffic 74–88

J

Jackson, F. H., (joint author), a 32–38, 64–69, 72, 104
Job margin in concrete road construction 22
Johnson, Dean A. N., a. and r. 41–46, 148
Joint fillers, crack fillers 49, 51, 52, 150, 151
Joints:
  in brick experimental road 150
  in concrete pavements 28, 47, 49–52, 141–143

K

Kansas highways and related data 20, 32, 39, 40, 50, 51, 70, 71, 74, 89–96, 104, 149, 153, 158, 160, 166, 167.
  see also Federal-aid.
Kaolin 125
Kellermann, W. F., (author and joint author), a. 64–69, 72, 177–184
Kelley, E. F., (joint author), a 89–96, 104
Kelly, H. H., a 153–168
Kentucky highways and related data 20, 39, 40, 50, 51, 70, 71, 89–96, 104, 149, 160, 166, 167
  see also Federal-aid.

L

Labor, *see* Drivers—Material handling.
Land rentals in concrete paving work 102, 103
Land requirements, rights of way, for highways 74, 77–80, 84, 85, 87, 148
Lanes, traffic 41–49, 73–88, 148, 149
Legislation, highway and vehicle 21, 55, 153–168, 185, 200
Liability, public 155, 156, 160–163, 165
Libraries receiving Public Roads, notice 52
License fees, licenses, and permits 39, 40, 46, 55, 70, 71, 155, 156, 158, 161–168, 198
Lighting:
  of highways, traffic lights 74, 75, 78, 86, 187
  of motor vehicles 157, 162, 164
Limestone, agricultural 25
Limestone concrete 32–38, 120, 136, 177–184
Limestone dust, limestone screenings 120
Liquid asphaltic materials, test requirements 89–96, 104
Liquid limits of soils and of soil constituents 58, 60, 121–130, 136, 170, 175
Load, loading, *see* headings beginning Compressibility, Compression, Flexural, Impact, Material, Pressure, Regulation, Static, Unloads.
Loam subgrade of experimental road 136
Local roads, county roads, township roads 20, 40, 70, 71, 185–194, 196
Louisiana highways and related data 11, 20, 39, 40, 50, 51, 70, 71, 75, 81–83, 89–96, 104, 149, 160, 166, 167.
  see also Federal-aid.

M

Macadam roads, bituminous macadam roads 18, 20, 104, 141, 143, 148, 149, 193
Machinery, *see* names of kinds of machinery—*also* names of tests and of processes in which machinery is used.
Maine highways and related data 10, 19, 20, 39, 40, 50, 51, 55, 70, 71, 89–96, 104, 149, 155, 156, 158, 166, 168, 200.
  see also Federal-aid.
Maintenance and costs of, highway 16, 18, 20, 70, 71, 104, 120, 136, 150, 151, 160, 169–176, 184, 185, 187, 193, 194.
Maps, *see* Columbia Island—Traffic studies.
Markers, traffic 76
  see also Signs and signals.
Markets, farm freighting 19

Page

"Marx plan" 156
Maryland highways and related data 10, 19, 20, 39–46, 50, 51, 54, 70, 71, 81, 89–96, 104, 137–149, 151, 156, 158, 166, 168, 200.
  see also Federal-aid.
Massachusetts highways and related data 10, 19, 20, 39–46, 50, 51, 56, 70, 71, 75, 76, 81–83, 86, 87, 89–96, 104, 149, 156, 166, 168.
  see also Federal-aid.
Massachusetts Institute of Technology, soil research 121–130, 136
Mass-production methods on secondary highways 185
Mastics, poured 49
Material handling in concrete paving 21–31, 97–103
Materials for road construction:
  cost data for concrete pavement construction. 21–31
  see also names of materials—*also* Material handling.
Mats, *see* Bituminous surface treatment—Concrete reinforcement.
Medial strips in highways 74
Mica as soil constituent, mica powder 123, 125, 128, 129, 136
Michigan highways and related data 10, 19, 20, 39, 40, 50, 51, 70, 71, 89–96, 104, 148, 149, 158, 167, 168, 185–200.
  see also Federal-aid.
Micrometer dials, micrometer adjustment 108, 138
Mileage data:
  highway and street mileages 1, 3, 14, 15, 20, 47, 55, 148, 149, 153, 154, 163, 185, 187, 189, 192, 194–196, 200.
  see also Federal-aid.
  vehicle mileages 1, 3, 4, 9, 10, 12–14, 19, 185, 189–194, 197–199
Mileage fees, motor vehicle 160
Mineral composition of concrete aggregates 32–38, 54, 178
Minnesota highways and related data 20, 32, 39, 40, 50, 51, 70, 71, 89–96, 104, 149, 156, 167, 168
  see also Federal-aid.
Mississippi highways and related data 20, 39, 40, 50, 51, 70, 71, 89–96, 104, 149, 160, 167, 168
  see also Federal-aid.
Missouri highways and related data 20, 39, 40, 47, 50, 51, 53, 70, 71, 81, 89–96, 104, 149, 158, 167, 168.
  see also Federal-aid.
Mixed-in-place treatment of topsoil road 172, 175
Moisture:
  protection of concrete bridge slabs against 105, 120
  see also headings beginning Water—*also* Capillarity—Consistency—Drainage—Evaporation—Liquid limits—Moisture equivalent—Plasticity—Shrinkage.
Moisture equivalent of soils 58, 59, 170
Molding:
  of concrete test specimens 33, 178
  of soils, effects 129, 130, 136
Montana highways and related data 20, 39, 40, 55, 70, 71, 89–96, 104, 149, 167, 168
  see also Federal-aid.
Mortar as cause of failure of concrete during freezing 33–38
Mortar voids ratios of test concretes 178
Motor vehicles:
  busses and bus transportation 3, 12, 39, 40, 42, 43, 54, 55, 81, 86, 137–147, 151, 154, 164 (fn), 167, 187, 189.
  motor cycles 39, 40, 154 (fn)
  number in United States, 1931 40, 153, 154, 163
  ownership 1–3, 10, 154, 155, 157–159, 164, 165, 185, 187, 190–192, 194
  persons per vehicle 3, 12, 13, 197, 198
  trucks and truck transportation 1–12, 19, 24, 26, 28, 39, 40, 42–44, 53, 55, 97–103, 132–136, 153–168, 187, 189, 194, 200.
  see also Gasoline consumption—Mileage data—Operating costs—Registration(s)—Regulation, motor vehicle—Tax exemption—Traffic studies.
Mount Vernon Memorial Highway 48, 57–63, 72, 86, 88, 148
Muck and sand fill, stabilization, a 57–63, 72

N

Naphtha 91, 95, 96, 171
National associations, boards, and conferences, *see* Regulation of motor vehicles.
Nebraska highways and related data 1–18, 20, 39, 40, 50, 51, 70, 71, 89–96, 104, 149, 155, 156, 167, 168
  see also Federal-aid.
Nevada highways and related data 1–18, 20, 39, 40, 70, 71, 89–96, 104, 149, 155, 167, 168
  see also Federal-aid.
New Hampshire highways and related data 20, 39, 40, 50, 51, 55, 70, 71, 89–96, 104, 131–136, 149, 155, 156, 167, 168.
  see also Federal-aid.
New Jersey highways and related data 19, 20, 39–46, 50, 51, 70, 71, 81–83, 89–96, 104, 149, 156, 167, 168.
  see also Federal-aid.
New Mexico highways and related data 1–18, 20, 39, 40, 70, 71, 89–96, 104, 149, 155, 158, 160, 167, 168
  see also Federal-aid.
New York (State) highways and related data 19, 20, 39–46, 50, 51, 53, 70, 71, 81–83, 86, 89–96, 104, 148, 149, 156, 160, 167, 168, 185.
  see also Federal-aid.

Page

Nonskid tratment of roads ... 169–176, 184
North Carolina highways and related data ... 20, 39, 40, 50, 51, 55, 56, 70, 71, 89–96, 104, 148, 149, 156, 158, 167, 168, 185.
see also Federal-aid.
North Dakota highways and related data ... 20, 39, 40, 50, 51, 70, 71, 89–96, 104, 149, 156, 167, 168
see also Federal-aid.

O

Ohio highways and related data ... 10 (fn), 20, 39, 40, 50, 51, 53–55, 70, 71, 89–96, 104, 148, 149, 155, 159, 167, 168, 197, 198.
see also Federal-aid.
Oil bath, use in viscosity test ... 93
Oil consumption ... 27, 198
Oil tax on motor vehicles ... 150, 158
Oil treatment of roads ... 17, 53, 169–176, 184
Oiled edge bars, oiled dowels ... 47, 51
Oils, *see* headings beginning Bitumen, Oil, Oiled.
Oklahoma highways and related data ... 20, 39, 40, 50, 51, 70, 71, 89–96, 104, 149, 156, 158, 167, 168
see also Federal-aid.
Operating costs:
of equipment in road construction ... 28
of motor vehicles ... 16, 182, 184, 193, 194, 198
Oregon highways and related data ... 1–18, 20, 39, 40, 50, 51, 55, 56, 70, 71, 81–83, 89–96, 104, 149, 155, 167, 168
see also Federal-aid.
Organic matter ... 58, 60, 121 (fn), 125, 127, 130, 171, 178
Overhead in road construction ... 22, 23
Oxidation of asphaltic materials ... 95, 96

P

Paraffine scale test of asphaltic products ... 92, 94
Parallel routes in highway design ... 6
Parking, vehicle ... 73, 74, 81–83, 163, 186, 187
Parkways ... 56, 79, 83–88, 148, 149
Patrols, highway ... 40(fn), 71, 159, 165–167
Paving requirements at highway intersections ... 78, 79, 85
Peabody, L. E., a ... 1–18, 131–136
Peat ... 52, 57, 58
Pedestrians ... 74, 77, 79, 81, 83, 156, 163
Penetration of bituminous materials, penetration tests ... 89–96, 104, 169–172, 174, 176, 184
Pennsylvania highways and related data ... 19, 20, 39–46, 50, 51, 53, 55, 70, 71, 89–96, 104–120, 149, 155, 167, 168, 185
see also Federal-aid.
Perishable products, truck freighting of ... 19
Permeability of soils ... 57, 59, 60, 125, 128, 130
Permits, *see* License fees.
Piston displacement, motor vehicle ... 158
Pitting of concrete ... 36–38, 66
Placing of concrete ... 54, 64–69, 72, 106, 119, 120
Planes of weakness, concrete pavements ... 47, 49
Planning, highway, *see* Improvement.
Plants, paving ... 22, 23, 29–31, 97–103
Plasticity of soils, plasticity index, plastic limit, plastic range ... 52, 58–60, 121–130, 136, 170(fn), 175
Population, traffic survey data ... 2, 6, 10, 12–16, 185, 187, 192, 194–196, 200
Porosity:
of concrete placed in deep forms ... 64
of soils, soil pores ... 59
Power and fuel, cost data ... 23–31
Pressure, pressures:
earth pressure, r. to p ... 52, 53, 56
inflation pressures of motor bus tires in impact tests ... 137–140
pressure requirements in reduction of moisture content of soils ... 59, 60
spring pressure, motor vehicle ... 139
Pressure cells ... 52, 56, 66
Pressure-gage ... 137(fn)
Primers, priming coats (bituminous) ... 91, 169–176
Production data for concrete road materials ... 21–31
Profit (job) in road construction ... 22, 23, 25, 28–31
Programs, highway construction, *see* Federal-aid—Improvement, highway—State highways.
Property damage and financial responsibility ... 155, 156, 160–163, 165
Property tax (personal) on motor vehicles ... 158
Proportioning of concrete:
methods and proportions used ... 25, 32–38, 47, 49, 53, 65, 105, 119, 120, 136, 150, 178, 180, 181
proportions of constituents, determination of ... 54, 66, 67, 72, 151, 152
see also Batching plant.
Publications, *see* Bibliography.

Q

Quarrying, cost data ... 21, 23–27
Quartz powder ... 128, 129

R

Railroads and transportation by ... 19, 21, 23–26, 28, 30, 31, 55, 153, 154, 157, 159–162, 165, 166
Ramps ... 88, 97
Reciprocity provisions in motor vehicle laws ... 158, 159, 161, 164–166
Refund reserves, refunds ... 40, 70, 71
Registration(s) and registration fees, motor vehicle ... 2, 3, 10–12, 39, 40, 46, 55, 132, 153–155, 158, 159, 163, 164 (fn), 187, 192–194, 197–200
Regulation, motor vehicle ... 55, 153–168, 200
Residues from tests of bituminous materials ... 90–96, 171, 176, 184

Page

Re-treatments, bituminous ... 169–176
Revenues, highway ... 40, 55, 70, 71, 192, 193
see also Expenditures—Federal-aid.
Rhode Island highways and related data ... 20, 39, 40, 50, 51, 70, 71, 89–96, 104, 149, 156, 160, 167, 168
see also Federal-aid.
Rights of way, *see* Land requirements—Regulation, motor vehicle.
Rigidity, static, *see* Shearing resistance.
Riprap ... 25
Roadside stands, wholesale ... 19
Rodding of concrete ... 178
Rotors, rotary traffic ... 74–88
Roughness, smoothness, of roads ... 48, 50, 54, 137–147, 151, 164 (fn), 169–176, 184
Routes, through, in United States ... 15, 16
Rubble ... 25
Rupture, moduli of, of concrete ... 33, 34, 54, 56, 177–184
Rural highways, *see* Farm freighting—Federal-aid—Local roads—Traffic studies.
Rusting of steel reinforcement ... 119, 120

S

Safety (highway), safety zones, traffic islands ... 45, 55, 74–88, 148, 153–167
Salaries and wages ... 21–31, 38
Sand-clay roads, *see* Earth and gravel roads—Topsoil.
Sand cushion, use in brick pavement ... 150
Sands and sandy soils, sand aggregates ... 21–25, 32, 53, 57–63, 65, 72, 98, 105, 121, 125, 128, 151, 152, 169–178, 184.
Saw, circular ... 34
Scalelike particles in soils ... 128, 136
Scaling:
of concrete, freezing test data ... 35–38
of surface treated soil roads ... 169, 174
Seal coats (bituminous) ... 169–176
Segregation:
of aggregates ... 65–67, 69, 72, 120
of water in concrete placed in deep forms ... 64–69, 72
Settlement of soils, fill settlement ... 60, 129, 130, 142, 144, 150
"Share expense" transportation ... 160
Shearing resistance, sliding resistance, of soils ... 53, 58, 121, 123–125, 129, 130
Shrinkage:
of soils, shrinkage limit ... 57–60, 62, 63, 121, 122, 125, 129, 130, 170
see also Contraction—Cracks.
Sieves and sieve analyses ... 32, 57, 58, 65, 67, 151, 152, 170, 176, 178
Signs and signals, traffic ... 55, 73–75, 77–79, 81, 84, 86, 88, 156, 163
Silts and silty soils, silt content of soils ... 58, 59, 65, 125, 127, 130, 136, 170, 178
Skidding, nonskid road ... 73, 169–176, 184
Slag ... 23, 32–35, 37, 169, 171–176
Slump of concrete ... 64 (fn), 65, 67–69, 72, 106, 178
Smoothness, road, *see* Roughness.
Softening of aggregates and of mortar ... 33–38
Soil classification ... 53, 57, 121, 124, 130, 136
Soil constants ... 53, 57, 58, 136
Soil grains, size and shape ... 128, 129
see also Sieves and sieve analyses.
Soil groups, subgrade ... 57, 58, 170 (fn.), 175
Soil layers ... 60, 130
Soil profile ... 53, 60, 61
Soil samples, drying of, effect ... 127, 130
Soil tests ... 52, 53, 121–130, 136
Solubility of bituminous materials ... 90–96, 171, 176
South Carolina highways and related data ... 20, 39, 40, 50, 51, 53, 70, 71, 89–96, 104, 149, 156, 167–176, 184.
see also Federal-aid.
South Dakota highways and related data ... 20, 39, 40, 50, 51, 70, 71, 89–96, 104, 149, 156, 167, 168
see also Federal-aid.
Spading of concrete, spading tool ... 65–69, 72, 178
Spalling of concrete ... 35–37
Span length of concrete specimen, effect upon flexural strength ... 177–184
Specific gravity:
of bituminous materials and distillates ... 91, 92, 94, 171
of concrete aggregates ... 56, 65, 67, 178
of soils ... 58, 59, 122, 129
Specific viscosity, *see* Viscosity.
Specifications:
for liquid asphaltic materials ... 89–96, 104
for motor vehicles, standardization ... 166
Speed, vehicle ... 18, 41–43, 52, 54, 73–81, 83, 85–88, 102, 103, 137, 139–147, 151, 156, 162–164, 166, 167.
Stability of soils, *see* Atterberg soil tests—Stabilization.
Stabilization:
of base courses of surface-treated roads ... 175, 176
of muck and sand fill ... 57–63, 72
State governmental agencies, tax exemption ... 39, 70, 150
State highways and related data ... 20, 39–46, 50–56, 70, 71, 131–136, 148–150, 153–176, 184–200
see also Federal-aid.
Static load, tests and r. to p ... 53, 54, 105–120, 137–139, 145–147, 151
Static rigidity, *see* Shearing resistance.
Steel and steel reinforcement, tie bars ... 21–23, 28, 30, 47–53, 56, 105–120
Sticky limit of soils, adhesive properties of soils ... 121 (text and fn.), 128

Page

Stockpiles, material handling ... 21–31, 97–103
Stone:
refractory stone ... 25
see also Aggregates—Cover material.
Stop-watch studies, time losses ... 55, 97–103
Storage:
cold-storage plants ... 19
see also Batching plant—Curing.
Strain-gages ... 107–118
Strains in concrete, static and impact ... 54, 105, 107–118
Street cars, street-car tracks ... 79, 82, 149 (fn.), 156, 163
Streets, *see* City streets—Street cars.
Strength, strength ratios, *see* Age-strength relations—Compression tests—Flexural strength—Tension.
Stresses in concrete and in steel reinforcement ... 48, 53, 56, 105–120, 137, 164 (fn.), 177, 178, 183
Subgrade studies, subgrades ... 18, 23, 47, 48, 51–53, 57–63, 72, 121–130, 136, 150, 151, 169–171, 175
Subways, pedestrian ... 79
Surface treatment of roads, bituminous ... 17, 53, 104, 136, 149, 169–176, 184
Surveys, *see* Liquid asphaltic materials—Subgrade studies—Traffic studies.

T

Tack coat in surface treatment of road ... 172
Tank for application of static loads ... 107, 108
Tars, tar treatment of roads ... 53, 54, 94, 120, 136, 169–176, 184
Tax exemption, tax exempt vehicles ... 39, 70, 150
Taxation, taxes, tax revenues ... 23–25, 27–31, 40, 55, 70, 71, 150, 153, 155, 156, 158, 160–166
Taxis, *see* Hiring, for-hire, motor vehicles.
Teller, L. W., (joint author), a ... 105–120
Temperature(s):
air temperature, various effects ... 53, 119, 127, 128
application temperatures of bituminous materials, cold-patch mixtures, hot mixtures ... 91, 93, 95, 120, 169–176, 184
temperature corrections ... 91, 108, 118
testing temperatures ... 32–34, 90–95, 171, 176
Tennessee highways and related data ... 20, 39, 40, 50, 52, 54, 70, 71, 89–96, 104, 149, 158, 167, 168
see also Federal-aid.
Tension, tensile strength, tensile stresses ... 32, 53, 54, 65, 105, 109–120, 139, 178, 183
Terzaghi soil studies ... 52, 53, 121 (fn), 124, 128, 136
Tests and testing apparatus, *see* names of tests, names of materials tested, and names of kinds of apparatus.
Texas highways and related data ... 19, 20, 39, 40, 50, 52, 56, 70, 71, 89–96, 104, 149, 153, 160, 162, 167, 168
see also Federal-aid.
Thawing of concrete ... 32–38
Theft of motor vehicles, antitheft legislation ... 155, 163
Thickness, pavement and road surface ... 47–50, 120, 136, 176
Tie bars ... 51, 52
Time data, stop-watch studies ... 55, 97–103
Tires, motor vehicle ... 54, 110, 111, 132, 137–141, 150, 151, 157, 164, 167, 168
Topsoil roads, surface treatment ... 169–176, 184
Toughness of soils, toughness index ... 121, 124, 125
Tourist traffic in Michigan ... 185, 186, 197–200
Township highways, *see* Local roads.
Tractors, road ... 39, 40, 154, 157, 160, 168, 200
Traffic circles and squares, rotary traffic ... 73–88
Traffic congestion ... 41–45, 74, 86, 103, 131, 132, 159, 160
Traffic control ... 55, 73–77, 88, 153–168, 200
Traffic lanes ... 41–49, 73–88, 148, 149
Traffic studies, traffic surveys and data from ... 1–19, 41–46, 55, 75, 76, 79, 81, 83, 103, 104, 120, 131–136, 148, 151, 153–168, 175, 184–200.
Traffic variations (seasonal, holiday, time of day) ... 6, 11, 16, 41–43, 83, 187, 189
Trailers and semitrailers, motor vehicle ... 39, 40, 103, 154, 157, 158, 160, 163, 167, 168, 189, 200
Transportation, *see* headings beginning Traffic—*also* Farm freighting—Motor vehicles—Railroads.
Trap rock concrete ... 32–38, 136
Trap rock screenings, use ... 120
Trucks, motor, *see* Motor vehicles.
Trueness, surface ... 48, 50
see also Roughness.
Turning roads ... 74, 87, 88
Tuttle, L. S., (joint author), a ... 73–88

U

Unemployment, relief through highway construction ... 21–31, 38
Uniformity:
of concrete (composition, strength, test results) ... 49, 54, 64, 67–69, 72, 177–184
of soil mixture as affecting liquid limit determinations ... 126, 127, 130
Unloads, motor truck ... 19
Utah highways and related data ... 1–18, 20, 39, 40, 50, 52, 70, 71, 89–96, 104, 149, 155, 167, 168
see also Federal-aid.

V

Vegetables, transportation by motor truck ... 19, 55
Vehicle Code, Uniform ... 161, 163–165
Vehicle miles, *see* Mileage data.
Vehicles, motor, *see* Motor vehicles—Vehicle Code.

Page

Vermont highways and related data ..... 20, 39, 40, 50, 52, 55, 70, 71, 89–96, 104, 132, 149, 155, 156, 167, 168.
see also Federal-aid.
Vibration method of placing of concrete, effects .. 54, 64–69, 72, 106, 119, 120
Vibrators 64–66, 72, 106
Virginia highways and related data ..... 19, 20, 39–46, 50, 52, 54, 70, 71, 89–96, 104, 148, 149, 156, 160, 167, 168, 185.
see also Federal-aid.
Viscosimeters 90–93
Viscosity:
of bituminous materials, viscosity tests 90–94, 169–174, 176, 184
of soils, viscous flow ..... 121 (text and fn), 124
see also Liquid limits.
Voids, voids ratios 59, 123, 129, 178
Volatilization, volatilization loss, of bituminous materials 90, 92, 93, 95, 96, 176
Volume change:
in concrete aggregates during freezing 38
in soils, volume determination, volumetric change 48, 59, 121, 122, 125, 128
Volume of traffic, *see* Traffic studies.

W

Wages 21–31, 38
Washing machine for concrete 151–152
Washington, D.C., *see* District of Columbia.

Page

Washington (State) highways and related data .. 1–18, 20, 39, 40, 50, 52, 55, 70, 71, 89–96, 104, 149, 155, 167, 168.
see also Federal-aid.
Watch glasses 126
Water, *see* headings beginning Water—*also* Capillarity — Consistency — Drainage — Evaporation — Liquid limits — Moisture — Moisture equivalent—Plasticity—Shrinkage.
Water-cement ratio(s) of concrete 34, 38, 54, 65–67, 69, 72, 105, 106, 119, 178, 180
see also Proportioning.
Water gain in concrete placed in deep forms .. 64–69, 72
Water-logging of soils 58
Weakness, planes of 47, 49
Wear, wear tests:
of concrete aggregates 32–37, 178
wear of roads, *see* Condition data.
Weather, *see* Climatic conditions—Humidity—Weathering.
Weathering:
of concrete and of aggregates 35, 36, 38, 64
of surface treated roads and of materials for .. 176
Weighing operations in paving work, *see* Material handling.
Weight calculations, weight data (miscellaneous) 33, 37, 49, 65–67, 91, 105, 106, 110, 120, 151, 178
Werner, George, (joint author), a 32–38, 104
West Virginia highways and related data 19, 20, 39, 40, 50, 52, 53, 70, 71, 89–96, 104, 149, 167, 168
see also Federal aid.

Page

Westchester County, New York, intersection designs 83–86
Western States:
traffic survey ..... 1–18, 55, 154, 155, 164 (fn)
see also names of States.
Wheel loads, *see* Impact machine—Static load.
Width of highways, widening of highways ..... 6, 10, 20 (fn), 45, 47, 48, 50, 74–88, 104, 148, 149, 164, 169, 186, 187, 193.
Williamson, J. S., (joint author), a 169–176, 184
Willis, E. A., (joint author), a., r. to p 57–63, 72, 136
Wisconsin highways and related data ..... 10, 20, 39, 40, 50, 52, 70, 71, 89–96, 104, 149, 156, 167, 168, 197, 198.
see also Federal-aid.
Workability of concrete for bridge floor slabs 120
Workmen's compensation 29
Wyoming highways and related data 1–18, 20, 39, 40, 70, 71, 89–96, 104, 149, 155, 167, 168
see also Federal-aid.

Y

Yard layouts in concrete paving work 97–103
Yellowstone Park, traffic in 6

Z

Zones, safety, *see* Safety.
Zoning regulations 87

U. S. GOVERNMENT PRINTING OFFICE : 1933